

REMARKS

Claims 5, 10, and 15-18 have been canceled. Claims 1-3, 6-8, and 11-13 have been amended. Claims 1-4, 6-9, and 11-14 remain in the application.

The amendments clarify the text of the claims which were originally based on a direct translation from Japanese to English. Elements of claims 5, 10, and 15, have been incorporated into claims 1, 6, and 11, respectively.

Claims 1-18 were rejected under 35 U.S.C. 112, second paragraph. The rejection is traversed in view of the amendment above. Specifically, inconsistencies concerning the "input packet" have been eliminated from independent claims 1, 6, and 11.

Claims 1-4, 6-9, 11-14, and 16-18 were rejected as being obvious over U.S. Patent 5,557,609 to Shobatake in view of U.S. Patent 6,442,135 to Ofeck. Claims 5, 10 and 15 were rejected as being obvious over the Shobotake/Ofeck combination further in view of U.S. Patent 6,687,247 to Wilford. These rejections are traversed.

In the conventional technology, as shown in Figure 11 of the application, the output time of packet B is calculated based on the output (or transfer) time of packet A, which is determined in the process of the pipeline processing. Therefore, in the conventional technology, the output time of packet B cannot be calculated until the output time of the previous packet A has been determined. The arrangement means that the calculation of the output time of the packet B in the conventional technology should always wait until the previous packet A has been processed through the pipeline processing, and it causes delay of the shaping process when the pipeline processing is being used.

In contrast, the present invention can provide an apparatus and method for giving the output time for each packet belonging in the same flow even if pipeline processing is being used, and can be applied to a faster speed transmission environment.

Features of the invention

Specific features of the present invention: (1) the cache portion 22 shown

in Figure 1 is provided; (2) information of a packet belonging to the same flow is managed by the cache portion; and (3) the output time (transmission schedule) is calculated based on information on how many packets are being processed in the pipeline processing portion.

What is managed by the cache portion 22?

In the cache portion 22, a plurality of internal registers 26 are provided, as shown in Figure 5(b), and there are two fields of “number of packets K” and “packet length sum total B” are provided for each flow identified by the field of “flow identifier”. This means that the number of packets of the same flow (shown in the field of “flow identifier”) being processed in the pipeline processing portion 20 is memorized in the field of “packet length sum total”.

The “number of packets K” and the “packet length sum total B” are incremented when each packet is input to the pipeline processing portion 20, especially when the processing block 1 inquires the flow identification of the input packet through path 3 shown in Figure 1. On the other hand, the value of those two fields are decremented when a packet is output from the pipeline processing portion 20, especially when the processing block 7 notifies through path 7 shown in Figure 1 that the processing (time scheduling) for one packet being completed.

It means that the cache portion 22 manages “number of packets K” and the “packet length sum total B” currently processed in the pipeline processing portion 20 for each packet flow.

How is the transmission schedule of each packet determined?

The transmission schedule for the input packet is determined in the pipeline processing portion 20 with reference to the information stored in the management memory 21 shown in Figure 1, and detailed contents are shown in Figure 5(a). Based on the “latest scheduling time RT”, other information with respect to the “token” (“token value P”, “token addition interval L”, and “token added value TK”) are used for calculating “the next” transmission schedule of the input packet.

If the input packet belongs to the other packet flow, there is no problem in

the conventional technology. Similarly, if there is no other packet, which belongs to the same packet flow with the input packet, being processed in the pipeline processing unit, there is no problem either, even in the conventional technology. However, if there is at least one packet, which belongs to the same packet flow with the input packet, being processed in the pipeline processing unit, in the conventional way, the input packet should wait (in the buffer or other suitable place) until the time scheduling for the previous packet (the packet currently being processed) has been completed, because the “latest scheduling time RT” in the management memory will be renewed at the time when the time scheduling for the previous packet is completed. Therefore, “latest scheduling time RT” in the management memory cannot be used for the calculation of the time scheduling for the input packet in this case in the conventional technology.

However, the present invention can calculate the time scheduling for the input packet even if there is any other packets belonging to the same packet flow.

How does the present invention work for solving the problem in the conventional technology?

The cache portion manages “number of packets K” and “packet length sum total B” for each packet flow and notifies the “packet length sum total B” to the pipeline processing portion (refer to the processing block 2 through the path 4 shown in Figure 1), then the pipeline processing portion uses the value (“packet length sum total “B”) when calculating the time scheduling for the input packet with reference to the “latest scheduling time RT” in the management memory.

Therefore, if there is one packet A (assuming that packet length is n) belongs to the same flow is being processed in the pipeline processing unit and then another packet B (assuming that packet length is m) of the same flow input to the pipeline processing portion, the pipeline processing portion calculates the transmission schedule of the input packet B based on the “latest scheduling time RT” in the management memory and the packet length ($n+m$). Of course, the packet length (n) is used when the transmission schedule of the packet A in the pipeline processing portion. However, the transmission schedule of the packet A has not been reflected to the “latest scheduling time RT” in the management

memory because the packet A is also still being processed in the pipeline processing portion.

Under the above circumstances, if another packet C (assuming that packet length is o) of the same packet flow input to the pipeline processing portion, the pipeline processing portion calculates the transmission schedule of the input packet C based on the “latest scheduling time RT” in the management memory and the packet length ($n+m+o$).

If the processing for the packet A has been completed and then another packet C (assuming that packet length is o) of the same packet flow input to the pipeline processing portion, the pipeline processing portion calculates the transmission schedule of the input packet C based on the “latest scheduling time RT” in the management memory, which was renewed through the path 5 of Figure 1 at the time when the processing for the packet A was completed, and the packet length ($m+o$), which was renewed through the path 7 of Figure 1 at the time when the processing for the packet A was completed and currently managed by the cache portion.

In this manner, the present invention can calculate the transmission schedule for each packet of the same flow continuously even though they are still in the pipeline processing status. Also, this invention is suitable for application to a network requiring a very high speed transmission environment.

Shobotake and Ofeck and Wilford

- U.S. Patent 5,557,609 to Shobotake et al. discloses the pipeline process scheme for the ATM connection process, e.g., the pipeline process of this prior art is used for processing the ATM connection. In contrast, the pipeline process of the present invention is used for calculating a scheduling time for each packet to be transmitted for the purpose of flow control of the data packet traffic.

- U.S. Patent 6,442,135 to Ofeck discusses the time stamp used by a scheduling controller in order to determine the forwarding time of a data packet from the output port. What is shown and claimed in the present invention, and is not shown in Ofeck, is the present invention discloses how to allocate the scheduling time of a packet when another packets of the same packet flow are

being processed in advance in a pipeline process scheme.

- U.S. Patent 6,687,247 to Wilford is unrelated to the claimed invention, and is also unrelated to Shobotake and Wilford, thus, the combination proposed is improper. Column 7, lines 1-5 pointed out by the Examiner indicates "Network physical interface 210 also prepends a small number of bytes of interface information, consisting of the total packet length, input interface number, and the input interface type, to the packet. The packet is then sent to inbound receiver 220". This function is different from that which is claimed.

First, it is noted that none of the references solve the problem discussed in detail above. That is, Shobotake is directed to a switching apparatus which includes a processor for performing frame synchronization; Ofeck describes and monitoring system which allows for billing of internet services (Ofeck's reference to controlling the flow of packets is unrelated to the present invention); and Wilford describes a high speed routing system. Collectively, none of the references, alone or in combination, show or make obvious being able to provide the output time for each packet belonging in the same flow even if the pipeline processing methodology is being used.

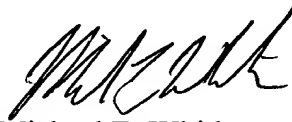
Second, none of the references show or suggest having a portion that manages information of a packet belonging to the same flow whereby the output time is calculated based on how many packets are being processed in the pipeline processing system. All claims in the present application are specifically directed to implementation in pipeline processing. Independent claims 1, 6, and 11, as amended, requires storing a latest scheduling time allocated to a packet which has been processed by the pipeline processing portion, and managing and storing a number of packets and a total sum length of packets that are being processed in the pipeline processing. The transmission scheduling time of a packet input to the pipeline processing portion is calculated by referring to the latest scheduling time and the total sum length of packets that are being processed. Since none of the references perform such a calculation, no combination of the references would make the claimed invention obvious.

The Examiner appears to have principally relied on Ofeck for its teachings concerning scheduling; however, with reference to column 7, lines 66-67 (referred

to by the Examiner), it can be seen that Ofeck is concerned with forwarding within a subset of time frames in a cycle, which is different from what is done in the present invention for the reasons outlined above.

In view of the above, claims 1-4, 6-9, and 11-14 should now be in condition for allowance, reconsideration and allowance of the claims at an early date is requested.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'ME Whitham', is positioned above the printed name.

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